Schaeffer reconsidered: a typological space and its analytical applications[1]

Andrea Valle

1. On the description of sound qualities

Is the description of sound relevant for music analysis? The answer to such a question seems obviously positive, but it depends indeed on what "sound" means in this context. Leaving the question intentionally open, it can be observed that the sonic level has an intuitive relevance not only for "music" (again, too general a term) but also for other practices, more or less related to it. As an example, sound design – a semantically very wide term, if only we consider the ethnographic abundance of different practices that it sums up in the actual historical/technological landscape - explicitly defines itself by referring to the acoustic and perceptual manipulation of the audible domain.[2] The need for a description of the sonic level in musicological studies has gained a first momentum with the structural analysis of electronic/electro-acoustic music, as, very simply, no other textual evidences were available, in contrast to instrumental music, were a "text" was indeed present - the score written on paper [Stroppa 1984]. Of course, this does not mean that a score is *the* textual level *par excellence* for analysis. Rather, the absence in the electroacoustic repertoire of a traditional support for analysis (providing a well-defined empirical foundation),[3] together with the perceptual awareness raised by the composing practices at its basis, has prompted since the 1970s a new interest in sonic description [Emmerson-Landy 2016]. It is now evident that analytical methods focusing directly on sound (that is, not through the mediation of other textual forms, e.g. written notation) could lead to new interesting perspectives on specific repertoires (e.g. electronic/electroacoustic music), propose new points of view for written "classical" works, create a bridge towards different genres and corpora (e.g. popular music), finally describe a general framework for all the practices referring, at various degrees, to the audible domain (e.g. sound design, multimedia).

But which description of sound?

The most immediate candidate in the actual historical and technological episteme (to speak with Foucault) is the physical (acoustic) description. Immediacy here indicates that such a knowledge is already available in a structured and assessed form, as a closed "knowledge packet" coming from outside the music field, a packet that is currently implemented as the default form in many tools that allow to access sound (i.e. audio software applications). Acoustics surely provides useful hints and cues, but it delivers information at a rough level with respect to perception. Acoustic categories are not suitable for an immediate use. Rather, acoustic information must be carefully treated to reach higher perceptual levels [Delalande 1998]. Such an approach is at the core of Auditory Scene Analysis [ASA, Bregman 1990], an ecological approach to audible perception that emphasizes the difference between (low-level) acoustic data and (high-level) perceptual information in terms of ecological and cognitive plausibility. In short, ASA, without demising the acoustic level (from which it starts), has shown that - in order to take into account audible phenomena - it is mandatory to rely on autonomous perceptual categories.[4]

In relation to the perceptual description of sound (and with an analytical purpose), three (overlapping) approaches can be retrieved in literature.

The first can be referred to as "phenomenological-perceptual categories" [Erickson 1975; Cogan 1984; Slawson

ISSN 2279-5065

1985]. While Erickson [1975] proposed an overall discussion of some aspects of sound in relation to music, Cogan [1984] developed a methodology in which spectral information over time is theoretically investigated by means of a set of categories based on Jakobson's classic phonological categories. Cogan applied the proposed methodology to a composite repertoire of music (from Ligeti to Tibetan chants). Slawson [1985] stepped again from phonology by proposing a limited but rather well defined theory of sound color that described timbre in its "atemporal" aspects (i.e. without considering time phenomena as transients): hence his specific reference to "sound color" rather than to "timbre". These three studies are explicitly focused on the development of categories to be used in analysis, and they confirm the usefulness of taking into account perceptual categories in the understanding of music phenomena, a point that has been emphasized also in relation to popular music [Tagg 1994; Fabbri 2008], that incorporates features both from oral traditions and electronic music production.

The second approach is centered on "timbral spaces". Slawson's proposal already included a two-dimension space inspired by phonology where various sonic features could be positioned and transformations among features could be operated. Many other spatial arrangements have been proposed [Plomp 1976; Grey, in Pierce 1983; Wessel 1979; McAdams-Saariaho 1991]. These studies show how the notion of space can be a fruitful analytical tool to highlight relations among many complex sound features, by suggesting sonic transformations in terms of visual/spatial mapping.

A third, in some sense isolated, approach has been proposed 50 years ago by Pierre Schaeffer in his notorious *Traité des objets musicaux* [Schaeffer 1966], with the explicit aim of investigating the audible domain avoiding the simple (and simplified) shortcut of a pure acoustic approach (what Schaeffer [1966, 416] called "physique amusante", referring to its previous attempts with A. Moles, see Schaeffer [1952]).[5]

2. Schaeffer revisited

Schaeffer's phenomenological approach led him, among the many other topics covered by his *Traité*, to articulate a theory both of listening practices and of sound objects. These two sides are strictly interrelated in Scaheffer's theoretical proposal, but I will not dive neither into the theory of listening nor in the epistemological discussion of sound object [Chion 1983; Thomas 1999; Valle 2004; 2006; 2008; 2016; Couprie 2000]: rather, in the following I will consider a small part of the theory of sound object in relation to sound description. After defining the status of the sound object, Schaeffer proposed a double analytical device in order to describe it: the well known «typo-morphologie». Schaeffer considered the «typo-morphologie»as a multifaceted tool for the description of all the objects of the audible domain.

In particular, while "morphologie" is intended as a description of the sound object *per se* (in its "contexture", to speak with Schaeffer), "typologie" is meant as the description of a sound object in relation with other objects (in its "contexte"). Thus, different epistemological assumptions can be retrieved on the two sides of the typo-morphology. Morphological criteria are defined as a set of (seven) analytical properties (i.e. parameters having different values, even if in a qualitative, not quantitive, form) characterizing a sound object. This morphological perspective has been developed further e.g. by Smalley that argued for a spectromorphology [Smalley 1986; 1999].[6] On the other side, typology offers a geometrical-topological description of the same object in terms of the position it occupies in a two-dimensional space. While the morphological point of view has been widely reconsidered, the idea of a typology as a "geography of sound" (a «cartographie du sonore potential», [Risset 1999, 156]) has never been consistently developed further.[7] For Schaeffer, the typology is intended as a "synthetic" description of the object: its inspiration is the process of «triage» of heterogeneous stuff in a loft [Schaeffer 1966, 430].[8] In short, given a collection of sound objects, the process aims at assigning every object a position in a space. In this way, objects can be assessed in their mutual relations.

Schaeffer's proposal is quite complex, as the French theorist presents various diagrams for the arrangement of the

features that he considers relevant. It must be noted that in the *Traité* the formalization operates *a posteriori*: first, six most relevant categories for sound description are identified (*masse*, *variation*, *dureé*, *entretien*, *facture*, *équilibre*), then they are tentatively combined in a 2-dimensional space for sake of simplicity and usability («dans le cadre d'une épure a deux dimensions» [Schaeffer 1966, 436]). Of course, if Schaeffer's criteria were intended to be orthogonal, we should expect a 6-dimension representation, indeed hard to be used.

But even if some correlations among criteria can be found, the reduction from six to two dimension is not an obvious operation. The resulting *tableau* features 35 classes (Fig. 1): each sound object can be assigned to a class (its type in the typology, provided as an alphabetic label). To be clear, the *tableau* is not intended to be entirely consistent. Schaeffer avowedly admits it by parenthesizing some of the classes resulting from the two-dimension reduction, as they could represent "impossible" sound objects (see the left- and rightmost classes in Fig. 1).[9]

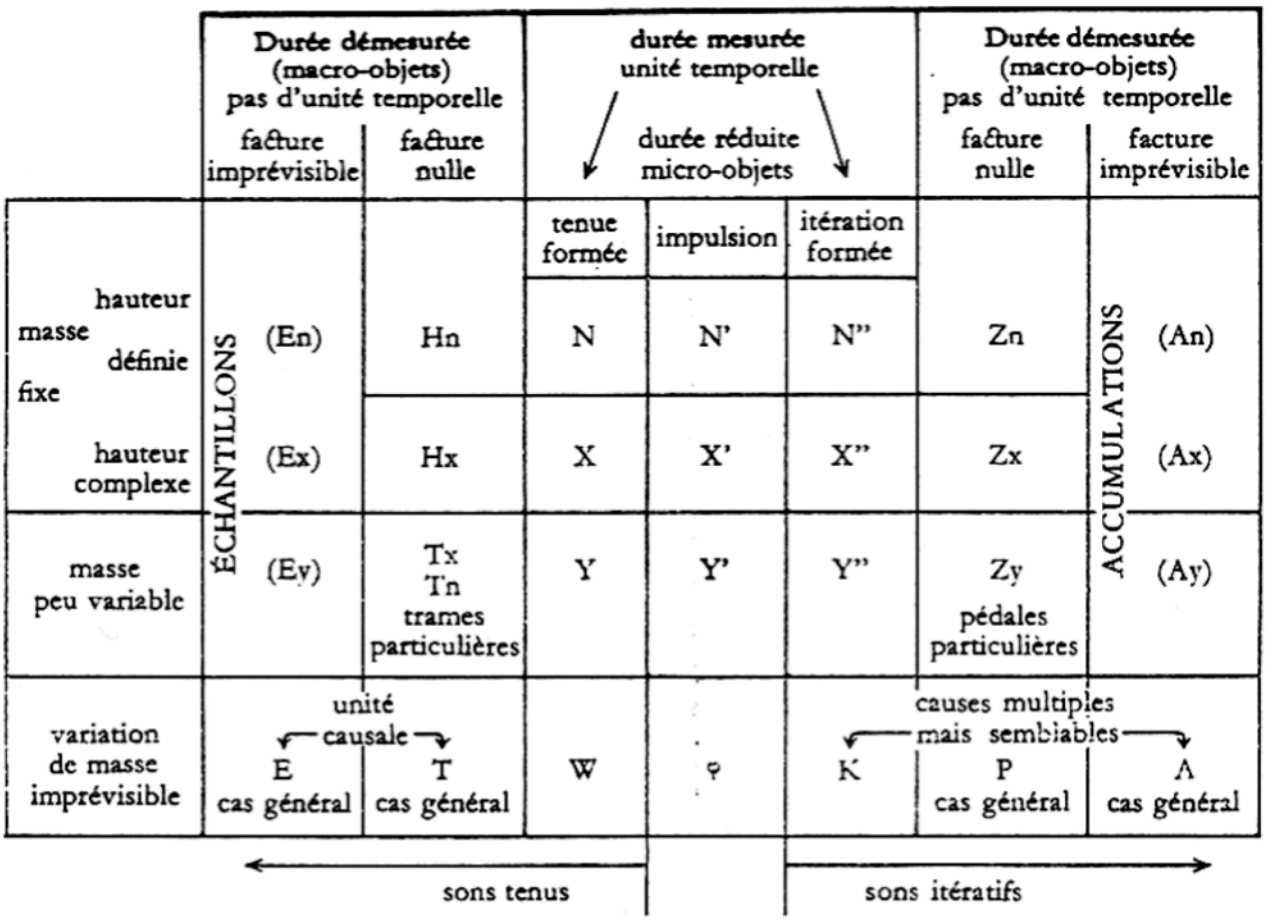

Figure 1. Schaeffer's 35 classes

With the awareness that «la recherche d'une typologie 'absolue' est illusoire» [Schaeffer 1966, 433], in the following I will propose a typological space that moves from Schaeffer's *tableau* together with a methodology for its use in analysis. A typological space should meet three criteria.

i) Continuity: rather than proposing a closed set of types a priori, it should define continuous dimensions. Types should then result as *a posteriori* partitions of the space;

ii) Consistency: the space should not leave room for "impossible" objects;

iii) Usability: the space should be usable as an intersubjective annotation tool

In order to build such a space, four semantic categories can be extracted from Schaeffer's original proposal: sustain, profile, mass, variation. These categories are not intended to exhaust the rather large range of sonic features that an analysis can detect. Rather, their aim is to provide a minimal, compact organization for a small but pivotal set of features that, at least tentatively, seems to be very general (hence, potentially useful).

Sustain can be proposed as a category for the description of sound objects' internal temporality. Schaeffer has suggested a linear organization in terms of continuous versus iterative, that describes the way in which a mode of production emerges from sound: continuous solicitation versus iterated action. Schaeffer also proposed impulsion as the "dispersion point" between the terms of the axis. An impulsive sustain is thus at the limit both of the continuous and the iterated. In fact, in the impulsion, the continuous feature is reduced to a single event, while iteration requires by definition a multiplication of a single impulse. Similarly, but from a general semantic perspective, Greimas and Courtès [1979, 111] have proposed to distinguish, in relation to duration, between "discontinuous duration (iterativity)" and "continuous duration". Thus, in relation to sustain, we have:

- *sustained:* constant activity over time;

- *impulsive:* activity as a singular moment;

- *iterative:* activity as a series of repeated contributions tool;

Internal temporality of sustain requires the definition of an external temporality, the profile. While sustain defines the way in which a sound object is maintained into duration, profile describes its external temporal form. Schaeffer has noted that there are substantially three modes in which audible time is appreciated: by constantly integrating time while the sound is enduring; by appreciating an overall time-form in an optimal memory frame; by catching a single event that is immediately thrown into the past. Semiotics has already proposed three categories (borrowed from grammar studies) to describe temporal aspectualization: durativity, inchoativity, and teminativity [Greimas-Courtés 1979]. In relation to the description of a (generic) process from the perspective of discursive semantics, inchoativity describes its triggering, durativity its enduring through time and terminativity its completion. Inchoativity leads to the expectation of the deployment of the whole process (durativity and terminativity), while the recognition of terminativity implies the previous semantic categories to be realized. From a paradigmatic perspective, durativity is opposed to punctuality, the latter being the absence of duration.

In relation to temporal macroform, it is thus possible to define three situations:

- *eumorphism:* relevance of all the three categories (inchoativity, durativity, terminativity). The sound object has a well-defined temporal shape;

- *amorphism:* durativity dominates, inchoativity and terminativity are made irrelevant. Amorphous sounds are sounds that last indefinitely;

- *anamorphism:* profile is compressed, inchoativity and terminativity coincide, durativity is irrelevant, rather the process can be described in terms of punctuality. It is the case of sound objects as pure events.

Sustain and profile, that is, micro- and macro-temporality, are orthogonal categories, with one exception. Eumorphous or amorphous sound objects may show a continuous or iterated sustain. But the two temporal categories collapse in the case

of objects with impulsive sustain and anamorphous profile.

As a third general (and indeed generic, but useful exactly because of this) quality of sound, Schaeffer has proposed the notion of mass (*masse*). Mass is intended as a generalization of the notion of pitch: «la masse d'un objet sonore, c'est sa façon d'occuper le champ des hauteurs» [Chion 1983, 145]. Even if Schaeffer refers to a "field" (*champ*), mass is organized along a linear *continuum*, from low to high register. Differently from pitch, mass does not take into account a single dimension, rather it is based on two notions: site - as a position on the continuum (i.e. as the actual register of the sound object) - and caliber - indicating properly a range of occupation. Pitched sounds thus have a limited caliber that allows an estimation, even if with variable precision, of their site (e.g. an actual pitch). "Noisy" sounds can be considered as having a greater caliber: in these cases, site can be estimated only as a register (e.g. low, medium, high). Schaeffer has indicated two extreme (technological) cases for mass: sinusoidal sounds, that have a specific site and a mass reduced to a point, vs. white noise, in which caliber has an extension that fills the whole axis, thus making the evaluation of site impossible/useless. Finally, temporality in specific relation to mass is articulated by Schaeffer by introducing variation as a criterion, that allows to describe how much the mass (both in its site and caliber) changes in time (from stable to varying objects).

These typological criteria can be organized into a 3-dimensional (plus 1) space [Lombardo-Valle 2014]. In the model, the space is defined by profile/sustain, caliber, variation and it is (at least formally) continuous.[10] Fig. 2 shows the resulting space. The horizontal axis refers from left to right to sustain (sustained, impulsive, iterative) and from center symmetrically to left and right to anamorphism, eumorphism, amorphism (as discussed, sustain and profile are orthogonal, apart in the case of the impulsive/anamorphism coupling). The vertical axis represents mass, and in particular caliber, increasing from top to bottom, while the *z* axis is intended to represent variation. Partitions of the space can be defined in order to represent sound object typologies (classes, in Figure 2 shown by labels inspired by Schaeffer [Lombardo-Valle 2014]).[11] An interesting possibility is to convert Schaeffer's qualitative space into a quantitative one by assigning an explicit and arbitrary range to the 3 (4) dimensions of the typological space. In Figure 5, the axes receive numerical ranges that have the only means of providing a reference for an explicit annotation. The model of this operation lies in the evaluation of human practices by a competent community. In this way, it is possible to differentiate sound objects belonging to the same class and to define trajectories in the space representing transformations of sound objects.

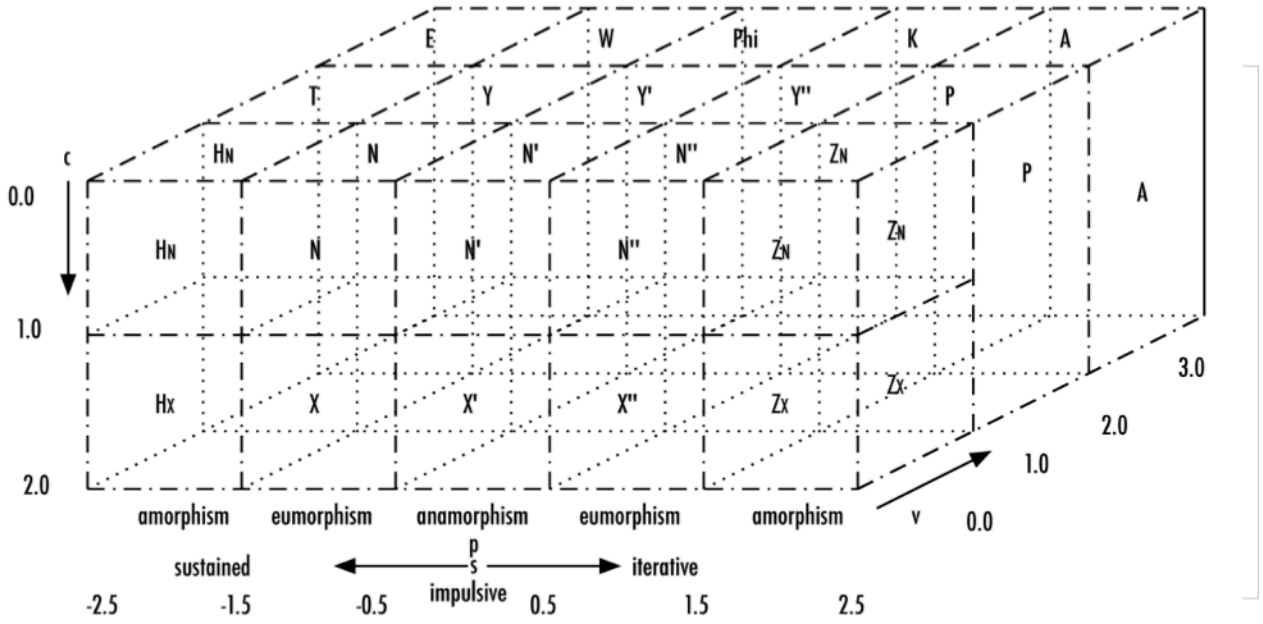

Figure 2. Lombardo-Valle's 3-dimensional sound criteria typology inspired by Schaeffer

In this typological space each sound object receives a unique definition in terms of a triple representing its position. The space is intended as a reference frame for a phenomenological mark-up of sound objects. Due to its typological nature, it is particularly well fitted for the annotation of sound object collections. The annotation process is operated by assigning each sound object a position in the space. This means that a quantification of the axes must be provided. As they are not related to any physical dimension, the measurement units are - *per se* - totally arbitrary, but the intersubjectivity of measurement assures a form of objectivity: the practice of annotation has its model not in physical measurement but in human-based evaluation of specific domains.[12]

3. The space in use

A typological space such as the one introduced above has two main purposes: it provides both an empirical layer on which to establish the analysis and an intersubjective annotation framework on which to assess it. These two aspects, while strictly related, indicate slightly different focuses: on the object side in the first case, on the community side in the second one.

A typological space is relevant for soundscape and multimedia/audiovisual domains, as in these practices there is an increasing need for analysis/classification tools of large collections of heterogeneous sound objects. Also, in the field of music analysis it may lead to identify specific organizations (e.g. trajectories or subspaces) in relation to certain musical corpora. In the following, I will discuss an annotation methodology that has been used in the analysis of various "sound texts". The methodology features three phases: the first is a local one, as it operates at the sound object level; the second one is general, as it deals with the overall collection of sound objects; the third phase is a feedback control procedure.

The local phase can be subdivided into 4 steps.

1. *Partition*: a crucial point is how to individuate the sound object in a sound continuum. Ultimately, this depends on a relevance criterion proper to a specific analytical perspective (e.g. that may affect the "size" of the object). In any case, Schaeffer has suggested the «articulation/appui» criterion [Schaeffer 1966, 396] as a way to isolate sound objects following a phonetic/instrumental energetic model. From a different perspective, Auditory Scene Analysis has proposed a set of heuristics that are at work in perceptual grouping, and that can be used as a guide (by the way, ASA heuristics can structurally lead to contradictory results, a normal behavior in audible perception);

2. *Figurative labeling*. Sound objects are labeled in a figurative way (e.g. "breaking glasses", "electric humming", "whisper" etc.). This is not intended as an analytical output: rather,labeling has proven to be useful both as a preliminary survey of the "cultural surroundings" of the object and as a mnemonic device when browsing the collection;

3. *Phenomenological evaluation*. This step is aimed at a phenomenological assessment of the four typological parameters by providing a verbal discussion. As an example, profile can be evaluated as "amorphous but near to eumorphism";

4. *Positioning*. Starting from the phenomenological discussion (3), the final step is to assign a numerical value to each parameter. The object is thus assigned a tuple (*profile*, *caliber*, *variation*) (e.g. 1.6, 1.8, 1.2) that defines its position in the space.

All the previous steps can be performed in a computer-assisted environment, as various tools can indeed aid the process (e.g. sonograms, filtering etc.).

Analitica, 8, 2015
ISSN 2279-5065

The global phase is aimed at collecting all the data retrieved in the local step, so that they can be processed and displayed. Here, two steps come into play:

1. *Archiving*. All the data have to be collected in a structured form (e.g. a data base). In this way, data can be parsed automatically both for exploring the resulting documentation and for visualization purposes. The latter aspect is at the core of step 2;

2. *Displaying*. Once data have been collected, it is possible to obtain an automatic representation of the objects' position in the space. Various technical solutions are available, depending on the analytical purposes;

A third, final phase of the process can be termed as "neighborhood evaluation". Once placed in the typological space, mutual positions of various objects can be assessed, in order to increase consistency by comparison. This step may lead to position re-assignment for some objects, thus providing a feedback control mechanism, back from the global phase to the local one.

1 water

1.1 Position (profile, calibre, variation)

(2.0, 1.8500000000000001, 0.0)

1.2 Remarks

Profile: iterative, amorphous, unchanging
Mass: nodal, large calibre, high textured
Variation: nodal, large calibre, high textured

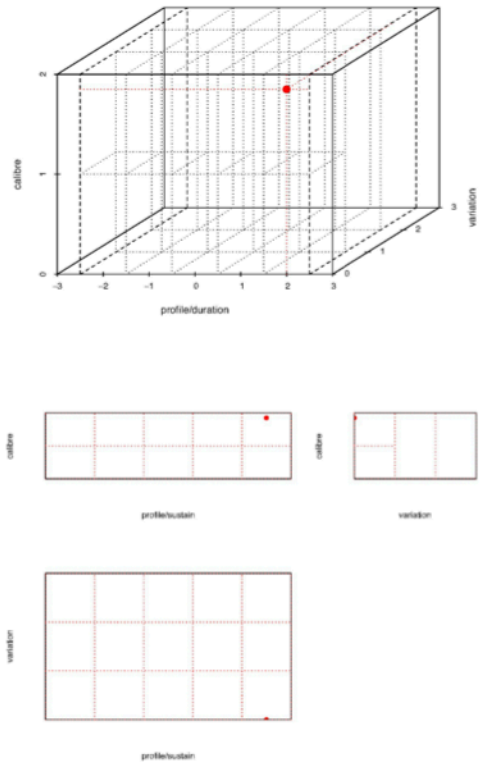

Figure 1 water: typological placement

Figure 3. Valle's annotation methodology employed for the analysis of various "sound texts": the case of the sound design in Hitchcock's *Psycho* murder scene (automatic visualization from the annotation)

As an example (and without discussing the results), Fig. 3 shows an automatic visualization from the annotation of the sound design in the murder scene from Hitchcock's *Psycho*. In relation to the local phase, Fig. 3, left, shows labeling (step 2), positioning (4) and phenomenological evaluation (3). Fig. 3, right, shows the typological space both in 3D and in an easier to read 2D sectioning. Fig. 4 shows the whole typological collection.

6 Summary

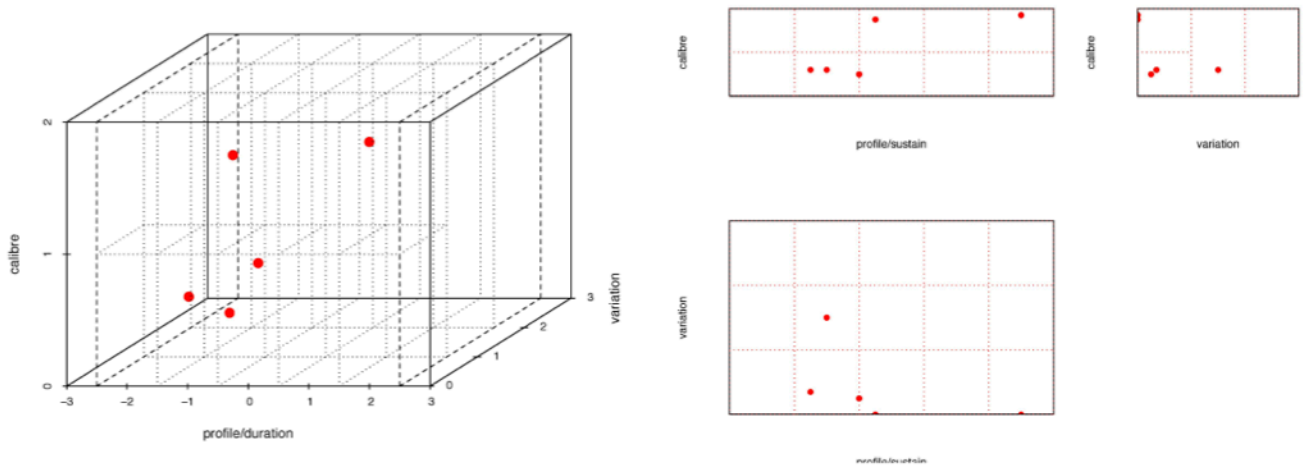

Figure 4. Valle's annotation methodology employed for the analysis of various "sound texts": the case of the sound design in Hitchcock's *Psycho* murder scene (whole typological collection)

4. Typological considerations on Varèse's Poème électronique

In order to provide a more in-depth example, I will introduce a preliminary analysis of Edgar Varèse's *Poème électronique*.[13] In particular, the analyzed audio material comes from the VEP project [Lombardo *et al*. 2009]), that reconstructed the entire *Poème électronique* multimedia show (audio and video) which took place in the Philips Pavilion at the 1958 Brussels Expo by means of virtual reality and binaural audio techniques. The music material for Varèse's *Poème électronique* is the unpublished original 3-track version prepared for the show by Varèse and the technician Willem Tak, as discovered by Kees Tazelaar [*ibid*.]. A very interesting feature emerges from the original tracks. An inspection of the three tracks clearly shows that such a multiple track organization does not depend on technology (its aim is not e.g. to exploit amplitude maximization by adding more tracks). Rather, the tracks are intended as three parallel layers prepared according to the principle of the «sensation of non blending» [Varèse 1971, 26]. In fact, each track unambiguously develops as a sequence of autonomous sound objects separated by silences. In the commercially available 2-track stereo versions, this chain-structure has become much more ambiguous because of the downmixing process, from 3 to 2 tracks: in its original form, it offers the possibility of studying through the typological space how «sound» is «organized», to speak with Varèse [1971]. A time-domain representation of first four minutes of the three tracks is shown in Fig.5.

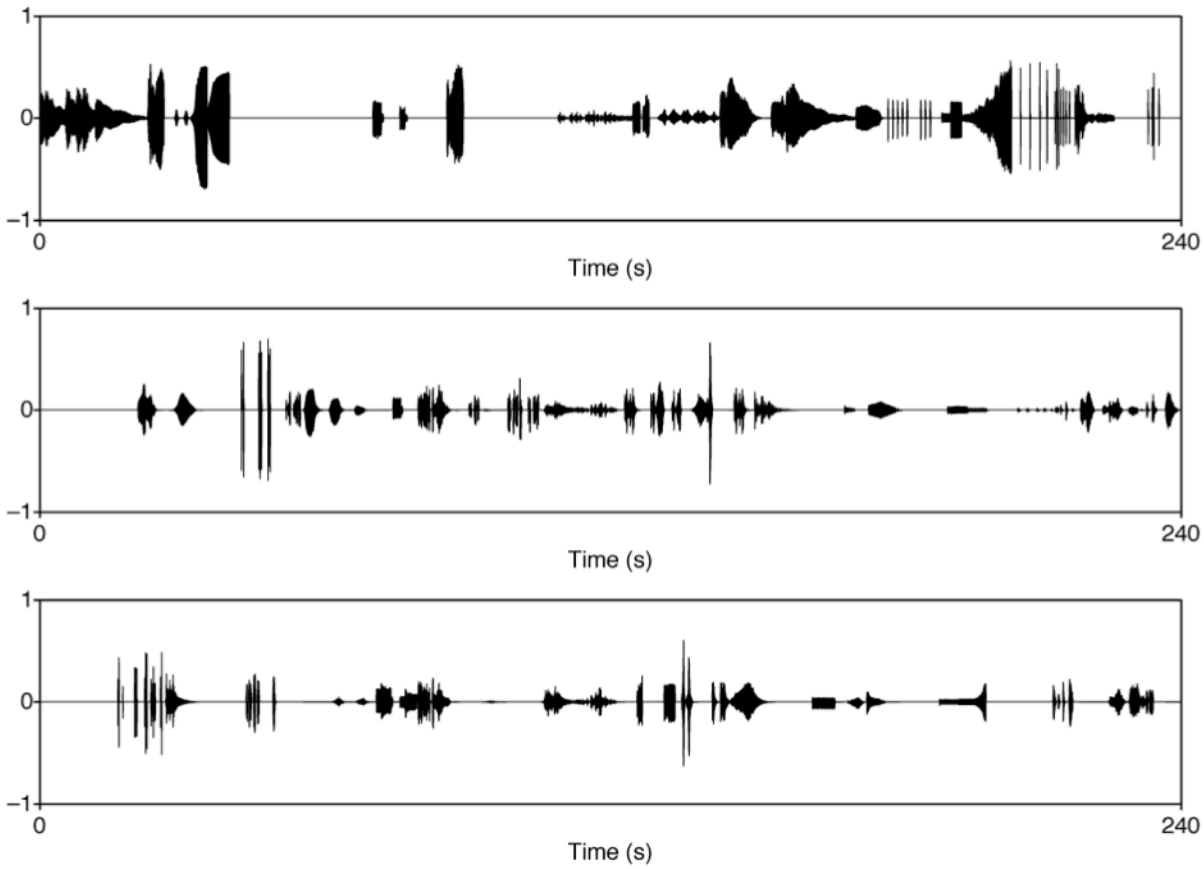

Figure 5. A time-domain representation of first four minutes of *Varèse's Poème électronique*

Varèse's non-blending feature is obtained in two ways, by horizontal and vertical segregation. Horizontal segregation results directly from the sequential structure of each track, where sound objects are separated by silences. Moreover, even if considering the three tracks altogether, there is a scarce overlapping of sound objects. This segregation can be defined as vertical, as it refers to simultaneous playing of the tracks. Horizontal and vertical segregations can be seen as separate phenomena. As the three tracks had to be played on different loudspeaker routes in the pavilion, sound spatialization could be used to keep sound objects separated even if they were simultaneous on the three tracks. Nevertheless, Varèse clearly opted for an extensive isolation strategy. In this sense, the sparse simultaneity of sound object among the tracks is further weakened by their assignment to different tracks, and hence by different spatial positioning.[14]

In relation to the previously introduced methodology, a fortuitous but fortunate consequence of the segregation strategy at work in *Poème électronique*'s original tracks is that typological partitioning is in some sense self-evident and not particularly critical. A typological study of sound materials in the three tracks maybe useful to investigate Varèse's composition strategies to "organize sound" in terms of sonic properties. The annotation process (by hand) led to recognize 100 sound objects, their data being stored on a textual file.

Figg.6-8 show some visualizations where the resulting sound objects are placed in the typological space.

Analitica, 8, 2015
ISSN 2279-5065

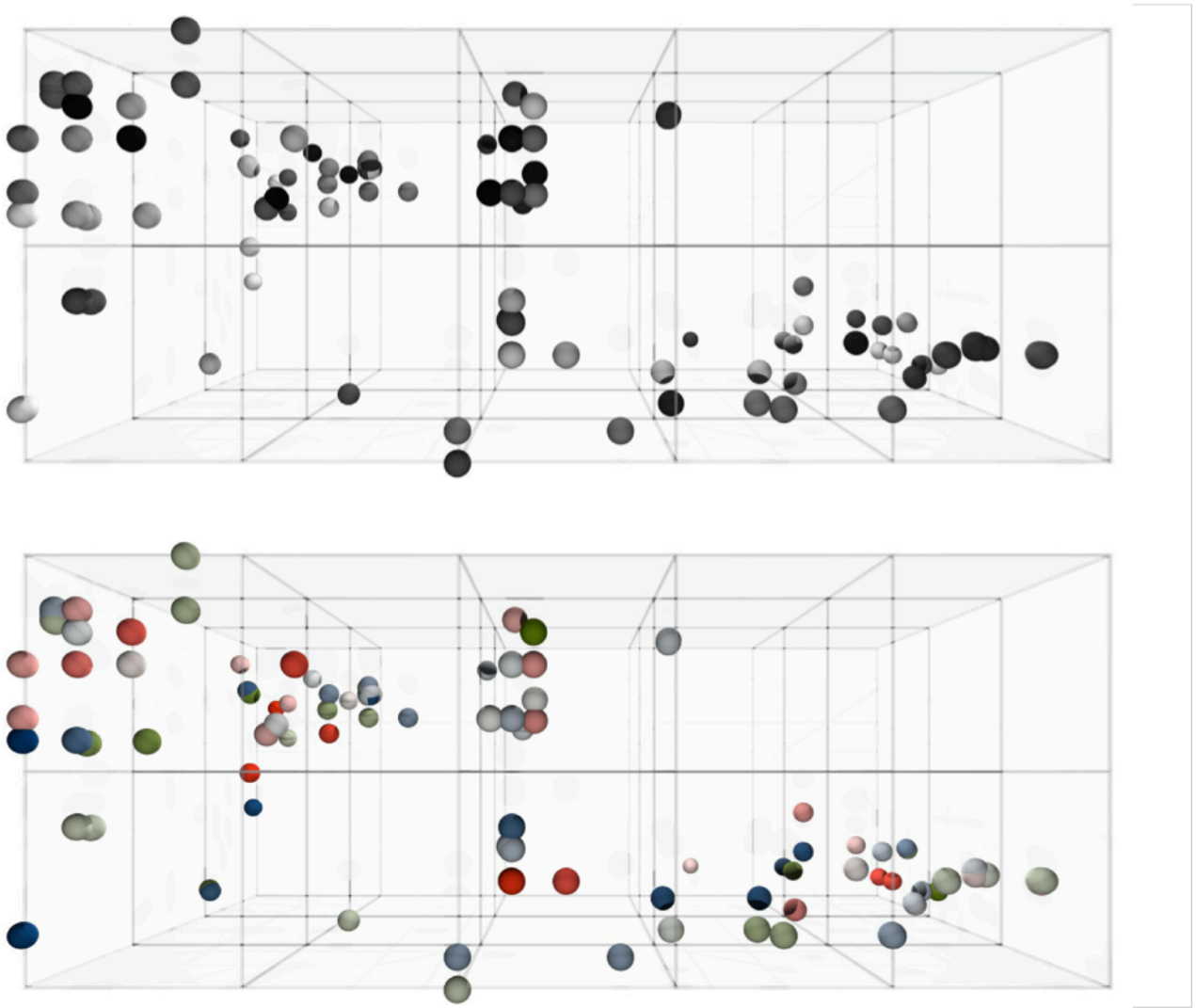

Figure 6. Visualization of the sound objects within *Poème électronique* placed in the typological space

Fig. 6 (top) proposes a 3D visualization where time information has been added. Each object receives a gray level from black to white in relation to its temporal position along the piece's duration. Fig.6(bottom)adds still a further layer of information, as here a color (red, green, blue) is associated to each track, where saturation (inverted with respect to Fig. 13, top) is associated to time placement (saturation is scaled proportionally to time).

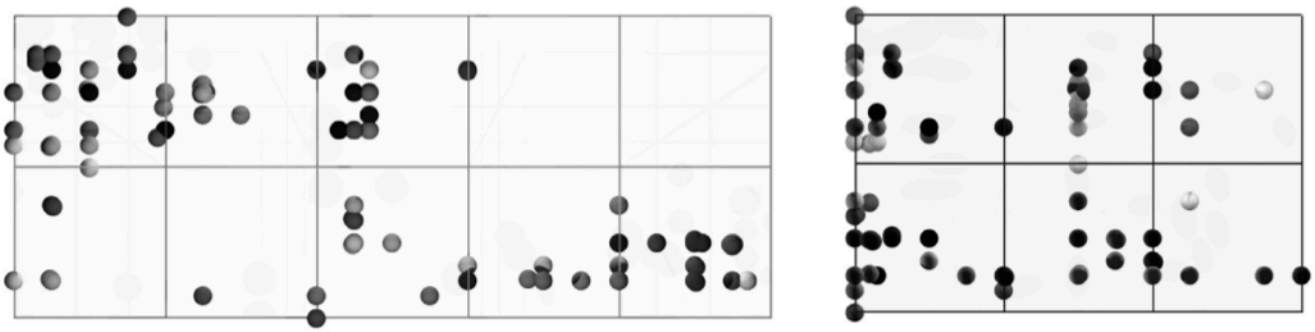

Figure 7. Visualization of the sound objects within *Poème électronique* placed in the typological space

Fig.7 proposes a 2D flattening from Fig.6 (top) for sake of readability, with *a* representing the front view and *b* a lateral

view.

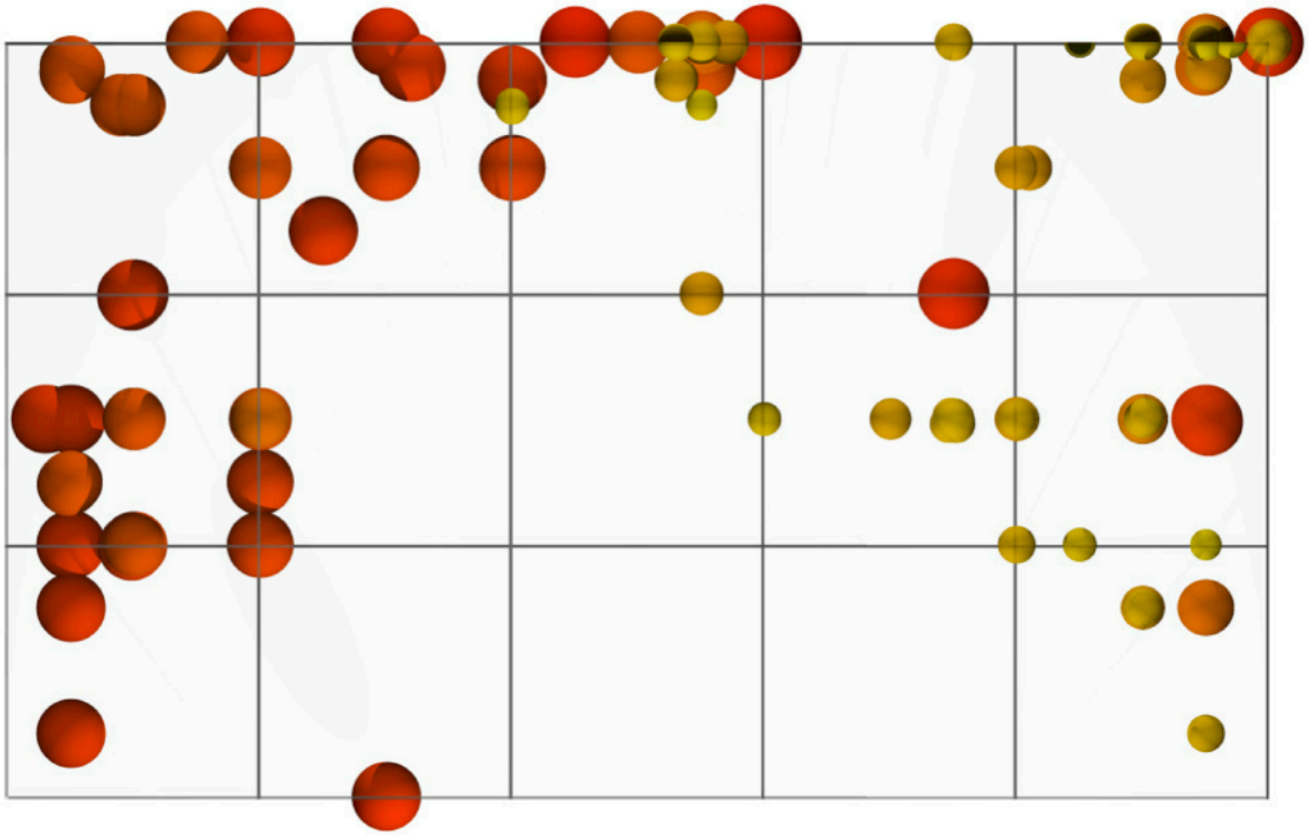

Figure 8 . Visualization of the sound objects within *Poème électronique* placed in the typological space

Fig. 8 proposes an orthographic view, from top to bottom, in which both color palette (from red to yellow) and diameter are scaled in relation to caliber (as the latter is no more accessible to view). Finally, Fig.9 and 10 are visual investigations on possible time organizations.

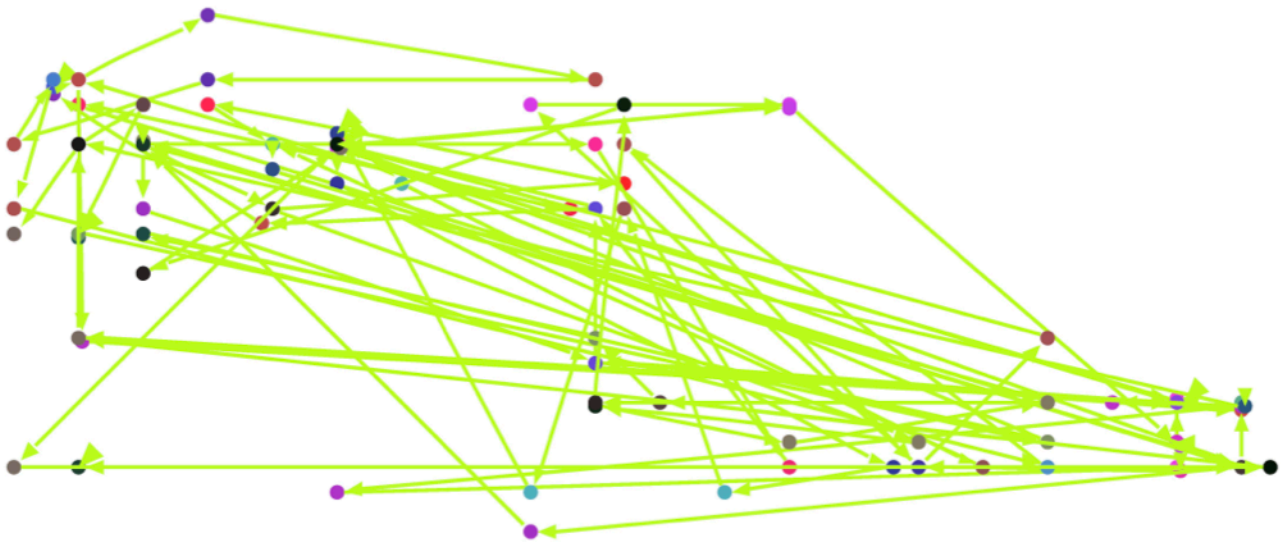

Figure 9. Visualization of the sound objects within *Poème électronique* placed in the typological space

Fig.9 represents, by means of the arrows, the actual sequencing of the object, their position depending on a frontal view of the space.

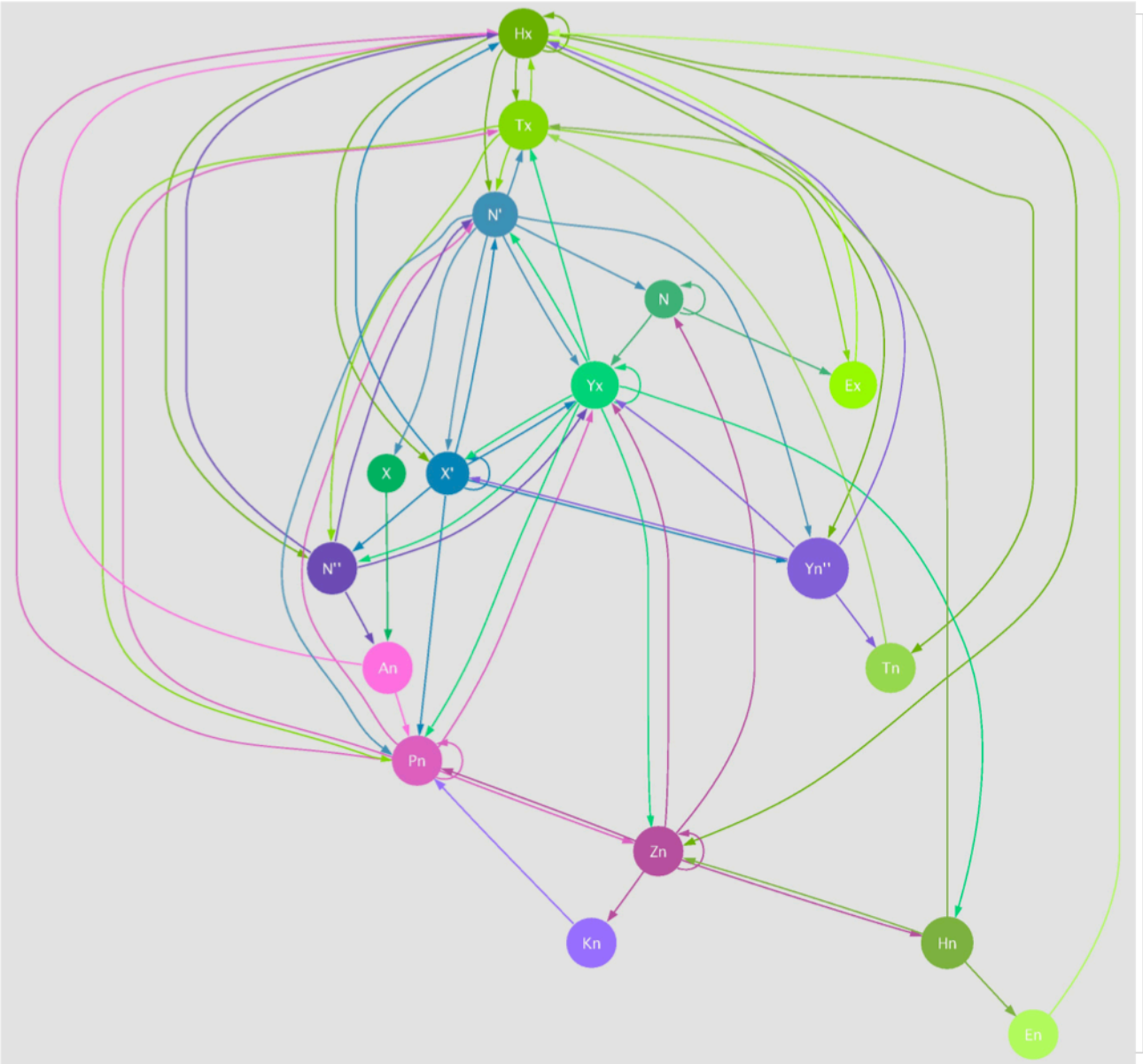

Figure 10. Visualization of the sound objects within *Poème électronique* placed in the typological space

Fig. 10 is based on a higher-level description, no more on sound objects, but on sound classes. Each vertex is a class that has occurrences in the collection, while arrows describes sequencing relations. While Fig. 9 was intended as an exploration in the sequencing of actual sound objects, Fig. 10 investigates the relevance of a sequencing grammar for object types.

Some preliminary observations can be drafted from *Poème*'s typological description. First of all, sound objects tend to occupy the space in a not uniform fashion. Many objects are placed in three subspaces: an impulsive zone in the middle, surrounded by few objects, and two lateral zones, the iterated, amorphous top left, with reduced caliber, and the

opposite corner on the bottom right, amorphous but continuous, with greater caliber. In this sense, the set of objects seems again to propose non-blending as a composition criterion, by clearly identifying almost separated subsets (emphasized by coupling caliber with sustain in the lateral sets). It could be noted that this sound organization is particularly apt for spatialization, as both short impulsive sounds and long, continuous ones allow the exploitation of opposite spatial features (respectively, localization and movement). As a second point, trajectories defining transformations among subsets of objects are not present. In this sense, Fig. 9 and 10 do not provide particularly evident clues. Still, a sort of basic sonic movement can be observed, in the form of a progressive movement towards an increase of variation and caliber that reveals a sort of slow crescendo in sonic complexity.

5. Conclusions

As a conclusion, I will discuss some critical issues and difficulties in the discussed typological space that emerged from usage. A first set of observations may be related to the evaluation of sound objects and their consequent positioning in the space.

Each of the proposed parameters reveals specific issues while trying to evaluate a sound object against it. For what concerns mass, the main difficulty is to define relative positions of sound objects in case of complex, internally articulated spectra (to speak acoustically), that is in relation to what Schaeffer called *sons cannelés* (chord-like structures). Intuitively, in relation to profile, there is a wide, grey area at the fuzzy border between eumorphism and amorphism, that is, in relation to termination and duration. Assessing variation can be difficult because, as noted by Schaffer, the evaluation of caliber becomes more difficult when variation increases. Finally, in relation to sustain, some cases demonstrate a transition or intermediate position between continuous and iterative (a musical example could be a very *stretto* bowing).

In relation to the practice of annotation, an informal test procedure was performed, by iterating evaluations of the same objects, resulting in a moderate oscillation (≈ 0.25 on the numerical scale provided for the typological space). It could also be debated whether a *gradatum*, with a higher resolution than the original class organization by Schaeffer, would make the annotation process easier to handle than the actual continuous definition of the space.

In general, the typological space needs to be refined and accurately fine-tuned. Nonetheless, it allows an explorative approach to sound description and the identification of trajectories and subspaces peculiar to specific corpora. A possible extension could be the implementation of "sonic browsers" (see Ethington-Punch 1994, Brazil-Fernström-Ottaviani 2003) for interactive approaches to analysis and exploration of sound collection.

References

Brazil, E. – Fernström, M. – Ottaviani, L. (2003), *Psychoacoustic validation and cataloguing of sonic objects: 2D browsing*, in D. Rocchesso – F. Fontana (eds), *The Sounding Object*, Edizioni di Mondo Estremo, Firenze, pp. 297-339.
Bregman, A. (1990), *Auditory Scene Analysis*, MIT Press, Cambridge (MA)-London.
Chion, M. (1983), *Guide des objets sonores. Pierre Schaeffer et la recherche musicale*, Buchet/Castel-INA, Paris.
Chion, M. (2009), *Guide To Sound Objects. Pierre Schaeffer and Musical Research*, English translation by J. Dack and C. North, ElectroAcoustic Resource Site, http://ears.pierrecouprie.fr/spip.php?article3597.
Cogan, R. (1984), *New Images of Musical Sound*, Harvard University Press, Cambridge (MA)-London.
Couprie, P. (2000), Pierre Schaeffer, Leonardo-On-Line, http://www.olats.org/pionniers/pp/schaeffer/schaeffer.php.

De Benedictis, A. I. (2009), *Le nuove testualità musicali*, in M. Caraci Vela (cur.), *La filologia musicale. Istituzioni, storia, strumenti critici*, vol. II, LIM, Lucca, pp. 71-116 (in collaboration with Nicola Scaldaferri).
De Benedictis, A. I. (2015), *Il suono oltre il segno: la carta, i limiti e gli inganni (cinque esempi)*, «AAA/TAC Acoustical Arts and Artifacts / Techonology, Aesthetics, Communication», 2, pp. 53-65.
Delalande, F. (1998), *Music Analysis and Reception Behaviours:* Sommeil *by Pierre Henry*, «Journal of New Music Research», 27/1-2, pp. 13- 66.
Emmerson, S. – Landy, L. (eds. 2016), *Expanding the Horizon of Electroacoustic Music Analysis*, Cambridge University Press, Cambridge.
Ethington, R. - Punch, B. (1994), *SeaWave: A System for Musical Timbre Description*, «Computer Music Journal», 18/1, pp. 30-39.
Fabbri, F. (2008, 3rd ed.), *Il suono in cui viviamo*, Il Saggiatore, Milano.
Greimas, A. J. – Courtés, J. (1979), *Sémiotique. Dictionnaire raisonné de la théorie du langage I*, Hachette, Paris.
Lombardo, V. – Valle, A. (2014, 4th ed.), *Audio e multimedia*, Maggioli, Milano.
Lombardo, V. – Valle, A. - Fitch, J. - Tazelaar, K. - Weinzierl, S. – Borczyk, W. (2009) *A Virtual-Reality Reconstruction of Poème Électronique Based on Philological Research*, «Computer Music Journal», 33/2, pp. 24- 47.
McAdams, S. – Saariaho, K. (1991), *Qualités et fonctions du timbre musical*, in J.-B. Barrière (cur.), *Le timbre. Métaphore pour la composition*, Christian Bourgois-IRCAM, Paris, pp. 164-181.
Pierce, J. R. (1983), *The Science of Musical Sound*, Freeman, New York.
Plomp,R. (1976), *Aspects of Tone Sensation. A Psychophysical Study*, Academic Press, London.
Risset, J.-C. (1999), *Pierre Schaeffer: recherché et creation musicalese et radiophniques*, in Thomas 1999, pp. 153-159.
Sallis, F. (2015), *Music Sketches*, Cambridge University Press, Cambridge.
Schaeffer, P. (1952), *A la recherche d'une musique concrète*, Seuil, Paris.
Schaeffer, P. (1966), *Traité des objets musicaux*, Seuil, Paris.
Schaeffer, P. (2012), *In Search of a Concrete Music*, English translation by J. Dack and C. North, University of California Press, Berkeley.
Scheier, E. D. (1996), *Bregman's Chimerae: Music Perception as Auditory Scene Analysis*, *Proc. Int. Conf. on Music Perception and Cognition*, s.p.
Slawson, W. (1985), *Sound Color*, University of California Press, Berkeley-Los Angeles-London.
Smalley, D. (1986), *Spectromorphology and Structuring Process*, in S. Emmerson (ed.), *The Language of Electroacoustic Music*, MacMillan, London, pp. 61-93.
Smalley, D. (1999), *Établissement de cadres relationnels pour l'analyse de la musique postschaefférienne*, in Thomas 1999, pp. 177-213.
Stroppa, M. (1984), *The Analysis of Electronic Music*, «Contemporary Music Review», 1/1, pp. 175- 180.
Tagg, P. (1994), *Popular music. Da Kojak al Rave*, CLUEB, Bologna.
Thomas, J.-C. (ed., 1999), *Ouïr, entendre, écouter, comprendre après Schaeffer*, INA-Buchet/Chastel, Bryn-sur-Marne-Paris.
Trainor, LJ (2015), *The Origins of Music in Auditory Scene Analysis and the Roles of Evolution and Culture in Musical Creation*, «Philosophical Transactions of the Royal Society A», B 370: 20140089.
Valle, A. (2004), *Preliminari a una semiotica dell'udibile*, tesi di dottorato in Semiotica, XV ciclo, Scuola Superiore di Studi Umanistici, Università di Bologna, Bologna.
Valle, A. (2006), *Eliche e bivalvi: sulla relazione tra ascolto e oggetti sonori a partire da Pierre Schaeffer* , «Semiotiche», 5, pp. 101-122.
Valle, A. (2008), *Tableaux et gravures. A Graph Model for Schaeffer's Theory of Listening*, Electroacoacoustic Music

Studies Network International Conference *EMS08 - Musique concrète - 60 years later*, Paris, INA-GRM-Université Paris-Sorbonne, available at http://www.ems-network.org/ems08/papers/valle.pdf

Valle, A. (2016) *Towards a Semiotics of the Audible*, «Signata. Annales des sémiotiques/Annals of semiotics», 6, forthcoming.

Varese, E. (1971), *The Liberation of Sound*, in B. Breoretz - E. T. Cone. (eds), *Perspectives on American Composers*, New York, Norton, pp. 25-33.

Wessel, D. (1979), *Timbre Space as a Musical eControl Structure*, «Computer Music Journal», 3/2, pp. 45-52.

Zattra, L. (2015), *Génétiques de la computer music*, in N. Donin – A. Grésillon – J-L. Lebrave (eds), *Genèses Musicales*, Presses universitaires de Paris Sorbonne, pp. 213-238.

---

[1] Preliminary, unpublished versions of this work have been presented at *Symposium International sur les Sciences du Langage Musical-SLM 3*, Bologna, SSSUB, 23-25/02/2006 (Valle, A., *A Topological Model for a Typological Space*) and *EMS07-The 'languages' of electroacoustic music*, Leicester, 12-15/06/07 (Valle, A., *A Typological Space for Representing Collections of Sound Objects*).

[2] The expression here and in the following simply refers to "all that can be heard". For a discussion from a semiotic perspective, see Valle [2016].

[3] See De Benedictis [2005; 2009], Sallis [2015, 69ss], Zattra [2015].

[4] Bregman [1990] has already dedicated an entire chapter (no. 5) to music. ASA is recently at the base of some musicological studies, see e.g. Scheirer [1996], Trainor [2015].

[5] Only recently, Schaeffer's work is available in English, thanks to John Dack and Christine North [Schaeffer 2012, also Chion 2009]. The two authors have also recently translated Schaeffer's *Traité* (*Treatise on Musical Objects. An Essay across Disciplines*, University of California Press, Berkeley, 2017).

[6] It could be observed that such a "morphology" of the "spectrum" roots back - contrary to Schaeffer's assumptions - morphology into acoustics.

[7] Of course, with the exclusion of timbral spaces, but the latter are not intended to be so general as Schaeffer's typology and are mainly based on psycho-acoustic assumptions rather than phenomenological ones.

[8] In the *Traité* the discussion on typology begins with the "parables du grenier" [Schaeffer 1966, § 24.1, 429ss]: in the heterogeneous congeries of the loft, «la difficulté de trier des objets matériels» [Schaeffer 1966, 430] can be solved only by assuming a homogenizing intention.

[9] Let us consider the case for *An*, that is, accumulations with a perceivable pitch. Schaeffer proposes a cloud of *glissandi*, like in many Xenakis' piece. As there is a strong variation of pitch (site) it could be though as a general *A* case, lowest row, as there is a variation of mass. Without such a variation, the same sound object could be assigned to *Zn*. Thus, uniformity among the classes in the *E/A* columns is gained only by referring to "facture", a criterion that here we do not consider. In any case, as already said, Schaeffer frankly admits some difficulties in classifying objects by these classes as he parenthesize them. For an in-depth discussion, see Valle [2004].

[10] As an example, it is possible to think of increasing caliber so to move from N objects to X objects, e.g. in the case of flute emissions, from a very "pure", almost sinusoidal, sound to breathed sound that eventually becomes white noise.

[11] It is possible to describe three subspaces in the diagram, that according with Schaeffer can be termed as "regions": central, homogeneous and heterogeneous one (see Lombardo-Valle [2014]).

[12] As an example, one can consider mountain climbing guidebooks, in which scales have been designed to evaluate climbing difficulties. The latter depend both on the actual average skills of the mountain climbing community and on physical properties of the sites. Even if there can be discrepancies among evaluations provided by different guidebooks, more or less they all agree around an average value (if not, the guidebooks would not only be useless, but above all dangerous).

[13] In the following discussion, even if I draw some conclusions, my aim is mostly methodological.

[14] Spatialization of sound is not taken into account here (but see [Lombardo *et al.* 2009]). Spatialization, referred originally as "intonation", was implemented after tape production by the technician Tak following Varèse's indications. By considering only the typological level, it can be noted that spatialization is in any case fundamental in a typical Varèsian sense, that is, *inside the sound* (e.g. sounds include concrete sirens and various *glissando*).